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Evaluation of Diatomaceous Earth Efficiency as an Antiparasitic for Controlling Gastrointestinal Helminths in Fattening Cattle

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Diatomaceous earth (DE), composed primarily of amorphous silica from fossilized diatoms, has garnered attention as a natural alternative to synthetic antiparasitic agents in livestock production. This study evaluated the effectiveness of DE in controlling gastrointestinal parasites and improving growth performance in fattening cattle under tropical conditions in Orellana, Ecuador. Forty crossbred cattle were randomly assigned to four treatment groups: Control group (0 g/day), T1 (150 g/day), T2 (175 g/day), and T3 (200 g/day) of DE administered daily for 120 days. Faecal samples were collected and analysed using the McMaster technique to quantify parasitic loads of *Eimeria sp*., *Cryptosporidium sp*., and *Haemonchus sp*. Weight gain was measured periodically. Statistical analysis was conducted using a completely randomised design. The results showed significant improvements in weight gain in the DE-treated groups compared to the control ($p < 0.01$). The highest dose group (T3) achieved an average total gain of 34.6 kg (288.33 g/day), while the control group only reached 20.5 kg (170.83 g/day). The use of DE significantly reduced the oocyst count of *Eimeria sp*., with T3 showing the highest efficacy at 57.76%, in contrast to the control group treated without ivermectin, which exhibited a negative efficacy of −13.71%. No statistically significant differences were observed for *Cryptosporidium sp*.; however, numerical reductions were noted in all DE-treated groups. Additionally, *Haemonchus sp*. eggs were absent in all final faecal analyses, suggesting a strong suppressive effect of DE, although environmental factors such as temperature and humidity cannot be entirely ruled out. The study concludes that daily supplementation of DE at levels between 175 and 200 g/day is effective in enhancing weight gain and reducing gastrointestinal parasite loads in fattening cattle. DE presents a sustainable and cost-effective alternative to conventional anthelmintics, especially in tropical systems where parasitic resistance and reinfection pressure are high.
Keywords: Diatomaceous earth, animal health, gastrointestinal parasites, natural anthelmintic, tropical livestock.

INTRODUCTION

Gastrointestinal parasitism remains one of the most critical constraints in tropical cattle fattening systems, affecting weight gain, feed efficiency, and animal welfare. Common pathogens such as *Eimeria spp*. and *Haemonchus spp*. are particularly problematic in humid tropical climates, where environmental conditions favor parasite survival and rapid reinfection (Thrusfield, 1988; Williams et al., 2020). Traditional management of these infections has relied heavily on pharmaceutical anthelmintics, which operate by targeting specific biochemical and physiological processes within the parasites (Mendoza et al., 2015; Pinilla et al., 2020; Bekele et al., 2022). These drugs interact with enzymes, ion channels, structural proteins, and the transport mechanisms of molecules within the helminths to exert their effects (Yadav & Singh, 2011). Notable studies have indicated that the addition of diatomaceous earth can result in significant

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increases in milk yield and alterations in the chemical composition of milk, which are critical factors for dairy farmers seeking to optimise productivity and quality in their operations (Chang & Zhang, 2017; Ryman et al., 2013). Farmers have reported improvements in overall cow health and productivity linked to the use of diatomaceous supplements. highlighting their therapeutic properties (Al-yasiry *et al.*, 2017). However. the use of diatoms in animal health is not without controversy as debates continue over the long-term effects of such as animal welfare (Giri et al., 2022; Lamminen, 2021; Yaakob et al., 2015). The assessment of diatoms for parasite control in cattle focuses on the potential benefits of incorporating diatomaceous earth derived from diatoms. a group of microalgae into small livestock farmers (Fields & Kociolek, 2015; Madeira et al., 2017; Vinayak et al., 2015). This emerging area of research aims to explore how these microalgae can enhance to the overall health of dairy herds (Coulombier et al., 2021; Flórez Miranda et al., 2016; Lamminen, 2021; Madeira et al., 2017). Research findings suggest that diatomaceous earth not only provides essential minerals and nutrients but also acts as a natural agent for parasite control. resulting in reduced health issues (Fields & Kociolek, 2015; Mimouni et al., 2012; Yaakob et al., 2015). The effects of diatomaceous supplements are influenced by numerous factors. including breed differences. nutritional intake. and environmental conditions. all of which play a role in shaping the chemical composition of milk produced by dairy cows (Flórez Miranda et al., 2016; Lamminen, 2021; Lodge-Ivey et al., 2014). Overall. the assessment of diatoms in cattle health presents a promising avenue for reducing the use of chemical agents in livestock farming. but further research is necessary to fully understand the implications and optimize their use within the dairy industry (Dijkstra et al., 2024; Durmic et al., 2024; Hristov et al., 2024; Mendel et al., 2017). As the interest in sustainable and health-promoting feed additives grows may become a key component in future dairy management practices aimed at enhancing both productivity and animal welfare (Manuelian et al., 2021). Therefore, this research used diatomaceous earth to determine its effect on gastrointestinal parasites in fattening cattle and whether it merits to use as a natural alternative dewormer for controlling gastrointestinal parasitosis. The objective of this study was to evaluate the deworming effect of diatomaceous earth on the control of gastrointestinal helminths in fattening cattle.

MATERIALS AND METHODS

***Area study*:** This research was carried out in Orellana province of Ecuador. The climate in the area corresponds to a tropical rainforest. where the average rainfall reaches 2942 mm and the average annual temperature is 29.7 °C (Lozano et al., 2020).

Treatment and experimental design: *This study evaluated the effect of three treatments using diatomaceous* earth on the control of gastrointestinal helminths in cattle fattening. These treatments were compared with a control treatment under a completely randomized design with a combinatorial arrangement where Factor A corresponds to the diatomaceous earth levels. Factor B corresponds to the sex of the animals (Equation 1)

Control = 0 g/day
T1 = 150 g/day
T2 = 175 g/day
T3 = 200 g/day

Which fits the following additive linear model:

$$Yij = u + \alpha i + \beta j + \alpha\beta ij + \in ijk \quad (1)$$

***Experimental procedure*:** Prior to the start of the study. animals of a similar age and weight were selected and subjected to experimental treatment. Groups of male and female cattle were placed in the pens. separating each treatment from the other with the aid of an electroplastic cord. The animals had to be adapted to the new feed for 8 days. as many of the animals did not consume diatomaceous earth. Diatomaceous earth was fed in the paddocks themselves using rubber feeders. To ensure the animals wouldn't reject the feed. the diatomaceous earth was mixed with wheat bran and coarse salt to improve its palatability.

***Data collection on experimental field measurements*:** Initial and final weight measurements were taken using an electronic weighing scale. It was interpreted in kilograms according to the tape measurements. This entire procedure was repeated every 35 days.

***Sampling and laboratory analysis*:** Faecal samples were collected directly from the rectum of the animals. using gynaecological gloves. in the early hours of the morning (Ticona et al., 2010; Mendoza et al., 2015). These samples were transported to the faculty laboratory using a thermo-refrigerator to preserve their structure for effective analysis. The McMaster technique was used for qualitative determination of parasites: 4 g of faeces were weighed and placed in a disposable cup to which 60 ml of SSS (saturated saline solution) was added. Using a spatula. the sample was mixed and homogenized and then sieved 5 to 6 times to reduce the particle size (Othman, 2017; Werne et al., 2023). The remaining liquid was subjected to the cocktail process. which consisted of passing the liquid from one cup to another approximately 10 times. Using a Pasteur pipette. the liquid was collected from the glass and placed in the McMaster chamber (Chhabra & Mafukidze, 1992). This sample was left to stand for 5 minutes and then observed under a microscope with a 10 × magnification lens. The egg count was performed by positioning the lens from the upper corner of the first quadrant. moving it from top to bottom and vice versa until all the grooves in the quadrants were covered.

Table 1. Biological behavior of fattening cattle at the Fátima experimental station because of using different levels of diatomaceous earth as an antiparasitic in the control of gastrointestinal helminths.

Item	Treatments				SEM	*P = value*
	Control g/day	T1 150 g/day	T2 175 g/day	T3 200 g/day		
Initial weight. Kg	152.00	153.20	152.40	152.90	2.45	0.9863
Final weight. Hg	172.50[b]	181.90[b]	187.50[a]	182.60[a]	2.58	0.0020
Weight gain. Kg	20.50[c]	28.70[b]	30.20[b]	34.60[a]	1.05	0.0001
Weight gain. g	170.83[c]	239.17[b]	251.67[b]	288.33[a]	8.73	0.0001
Initial *Eimeria sp* (opg)	13.56	10.11	9.42	13.09	1.66	0.2113
Initial *Haemonchus sp* (hpg)	3.71	3.83	2.71	2.87	1.66	0.8379
Initial *Cryptosporidium* (opg)	12.57	11.38	9.33	12.10	1.46	0.4195
Final *Eimeria sp* (opg)	15.42[a]	5.74[b]	6.80[b]	5.53[b]	1.36	0.0000
Final *Haemonchus* (hpg)	3.50	0.00	0.00	0.00	0.00	0.4031
Final *Cryptosporidium* (opg)	11.91[a]	2.87[b]	3.00[b]	3.37	0.00	0.9838
Orden Strongylidea (hpg)	0.00	0.00	0.00	0.00	0.00	1.0000

[a-c] Means with the same letters in the same row do not differ statistically according to the Tukey test.

RESULTS AND DISCUSSION

The crossbred cattle used in this study did not show statistical differences (P > 0.05). reaching average weights of 152. 153.20. 152.40. and 152.90 kg for treatments T0. T1. T2. and T3. in that order. So, it is considered that the weights were homogeneous. and a completely randomized design was used in this experiment (Table 1).

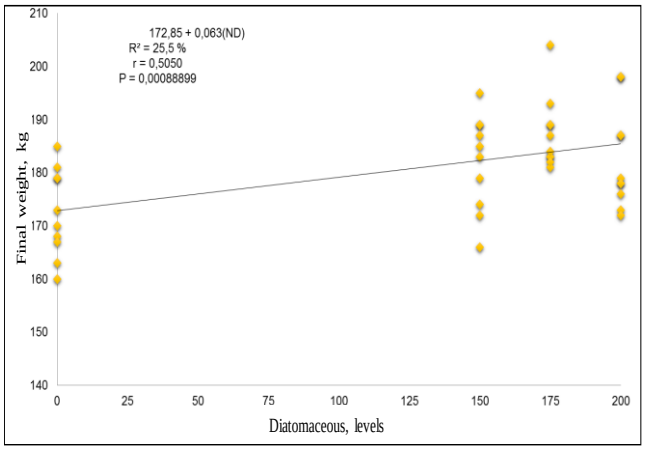

Figure 1. Regression for final weight (kg) because of using different levels of diatomaceous earth in fattening cattle as an antiparasitic in the control of gastrointestinal helminths.

After 120 days of research. the final weight variable of the cattle presented highly significant statistical differences (*P* < 0.01). Because of the different levels of diatomaceous earth. the best responses were 187.50 and 182.60 kg for cattle T3 and T2. respectively (175 and 200 g of diatoms/day). followed by T1 (150 g of diatoms/day). with 152.40 kg. Finally, the animals in Control (0 g of diatoms/day) weighed 172.50 kg. Thus, achieving the lowest weight within the treatments. According to Sadowska and Świderski (2020) that diatomaceous earth is highly indicated to supply the nutritional deficiency of animals since its mineral complement improves the assimilation of food, prevents its decomposition in the food bolus, stimulates appetite and vigor and above all the general health status (Lamminen, 2021). In the regression analysis, a highly significant linear trend was established (*P* <0.01) which determined that for each additional unit of diatomaceous earth the weight of the cattle increased by 0.063 kg (Figure 1) with a coefficient of determination of 25.5%, while the correlation coefficient was high at 0.5050.

Weight gain at the end of the 120-day study period showed highly significant differences (*P* < 0.01) due to the use of different levels of diatomaceous earth. The values were 34.60 kg for T3 cattle corresponding to 200 g of diatoms/day followed by T2 and T1 (175 and 150 g of diatoms/day) with 30.20 and 28.70 kg, respectively. Finally, control cattle (0 g of diatoms/day) weighed 20.50 kg. constituting the group with the lowest weight gain within the treatments. The data obtained can be compared with Mehedi et al. (2020) who used sulfadoxine as a method of deworming cattle and 90 days after its administration recorded a weight gain of 41.50 kg. According to Lodge-Ivey et al. (2014), sulfa drugs exerting the action of a bacterial enzyme responsible for the incorporation of para-amino benzoic acid into dihydropteroic acid, a precursor of folic acid. Preformed folic acid is required by mammalian cells and is more quickly utilized since they cannot synthesize it by themselves. The folic acid plays an important role in the haematological condition and body condition of animals (Orriss, 1997; Tomley & Shirley, 2009; Guamán-Rivera et al., 2024). For the variable weight gain at 120 days of research. highly significant statistical differences

were obtained ($P < 0.01$). Due to the use of different levels of diatomaceous earth. the best results were recorded in T3 (200 g of diatom/day) with a value of 288.33 g/day followed by treatments T2 and T1 (175 and 150 g of diatom/day) with gains of 251.67 and 239.17 g/day, respectively. Finally, the group of cattle from Control (0 g of diatom/day) with 170.83 g/day constituted this group as the one with the lowest weight gain within the experiment. González Marcillo et al. (2021) stated that feeding cattle with crop residues in the Amazon region. obtained a weight gain of 151 g/day at 131 days; this may be because they did not have any type of concentrate supplementation (Ortiz-Martínez et al., 2020; Vinueza et al., 2023). When evaluating a dewormer (ivermectin) in the body growth of Creole cattle, after 5 months of research, obtained weight gains of 175.5 g/day; inferring that the use of ivermectin alone does not favor adequate weight gain as it would when combined with nutritional correctors (ivermectin + calcium) or anabolics (ivermectin + zeranol). After 120 days of research, when analyzing the parasitic loads of cattle highly significant statistical differences were found ($P < 0.01$) because of the diatomaceous earth use. Recording values of 237.77 oocysts per gram of faeces (OPG) corresponding to Control (ivermectin 1%) followed by treatments T2 (150 g diatom/day) with 32.94 oocysts per gram (OPG); T3 (175 g diatom/day). with 46.24 oocysts per gram (OPG); and T14 (200 g diatom/day). with 30.58 oocysts per gram (OPG). According to the Tukey test. treatments T2. T3. and T1 do not differ statistically between them. but they do differ numerically, finding a lower oocyst count per gram (OPG) in animals treated with 200 g diatom/day with an effectiveness of 57.76%. Treatment Control (ivermectin) reported an increase in oocysts per gram (OPG) compared to the initial analysis, its effectiveness being negative (−13.71%). This phenomenon explains (Othman, 2017; Vinueza et al., 2023), where possibly these parasites come to develop resistance to anthelmintic drugs at the doses recommended by the manufacturers. Giri et al. (2022), when using diatomaceous earth as an antiparasitic in dairy cows at 90 days, achieved a reduction of OPG (oocysts per gram) of Eimeria sp. of 84%, an efficiency that exceeds that of this research (57.76%). In the regression analysis, it was possible to determine the changes that occur when using diatomaceous earth in fattening cattle. A highly significant linear trend was obtained ($P < 0.01$). It was established that if the level of diatomite is increased, the presence of OPG (oocysts per gram) decreases by 0.511 OPG (Figure 2), with a coefficient of determination of 46.85%, while the correlation coefficient was high at 0.6845.

After 120 days of research. parasitic loads did not report statistically significant differences ($P > 0.05$) for Cryptosporidium sp. parasites. Because of the use of diatomaceous earth, values of 8.46 oocysts per gram (OPG) were obtained. For treatment T0 (ivermectin 1%), 8.23 oocysts per gram (OPG); for treatment T1 (150 g/diatom day), 9 oocysts per gram (OPG); for treatment T2 (175 g/diatom day), 11.35 oocysts per gram (OPG); and finally. for treatment T3 (200 g diatom/day), 11.35 oocysts per gram (OPG). Although the data obtained for the Tukey test do not differ statistically, numerical differences are reported between treatments Control. T1, T2, and T3, being slightly higher and Control (ivermectin) with an efficacy of 76.85%. Cattle did not present a complete elimination of the parasite since it appeared at the beginning and at the end of the analysis, but a significant reduction in the parasite load. This phenomenon may be due to what (Romero-Salas et al., 2016) point out: the most common route of infection is oral-fecal contact since the oocysts present in the feces mix with the grass from where the animals take their food, thus producing a direct and rapid reinfection. King and Monis (2007) delve into the subject by explaining that oocysts are highly resistant to environmental stress and chemical disinfection because their thick wall has a complex protective barrier that provides protection and allows them to survive for long periods of time outside the host.

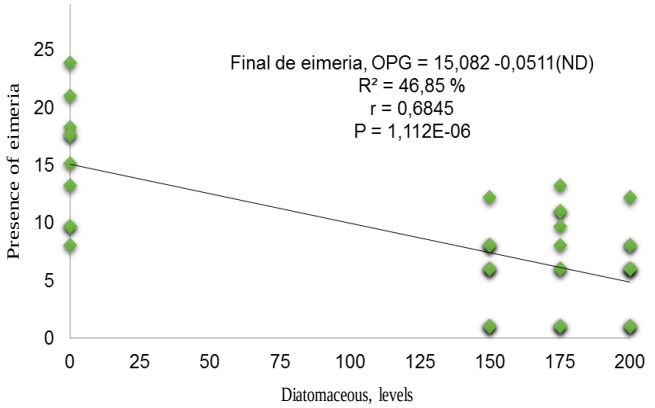

Figure 2. Regression for the presence of Eimeria (OPG). concluding the investigation into the effect of using different levels of diatomaceous earth in fattening cattle. as an antiparasitic in the control of gastrointestinal helminths.

For the nematode *Haemonchus sp.*. after 120 days of research analyzing parasitic loads in cattle. no statistically significant differences were found ($P > 0.05$). Because of the use of diatomaceous earth, negative values of eggs per gram (EPG) were recorded for all treatments Control, T1, T2, and T3 (150. 175. and 200 g of diatomaceous earth/day); no eggs of these parasites were found in fecal samples a phenomenon explained by Verdezoto-Moncayo (2015). *Hemonchus* eggs are very sensitive to environmental conditions, being more susceptible in periods when the ambient temperature drops. This can also be attributed to the action of diatoms. According to Islam and Rahman (2021) and Korunić et al. (2016). the way diatomaceous earth acts against larvae is through

dehydration since they are sustained by a fluid system and lose 10% of these fluids.

According to final weight, after 120 days of research showed significant differences ($P < 0.05$), recording a greater weight gain in males with 184.10 kg, unlike females, whose weights reached 178.15 kg (Table 2). Indicating the supremacy in weight gain of males over females, this is due to what was noted by Owens et al. (1993) in males. the protein mass of the animal grows in proportion to the weight, making better use of the protein, fat, and water that the animal accumulates. This is not the case for females that accumulate greater amounts of fat. which delays the increase in their protein mass. Borchert and Zellmer-Bruhn (2010) complements this by using molasses and urea in grazing cattle, achieving a final weight at 60 days of research in males of 400.4 kg, unlike females, who obtained a final weight of 364 kg. Thus, reaffirming that males have a greater weight gain than females. Hammes and Levin (2019) explains that males grow faster than females because androgens have a greater influence than estrogens on growth stimulation. also noting that males tend to consume more food than females because their metabolic rate is much higher than that of females.

Table 2. Biological behavior of fattening cattle from the Fátima experimental station due to the effect of sex when diatomaceous earth is applied as an antiparasitic in the control of gastrointestinal helminths.

Item	Sex		SEM	P-value
	Male	Female		
Initial weight. kg	153.20	152.05	1.73	0.64
Final weight. kg	184.10[a]	178.15[b]	1.82	0.03
Weight gain. kg	30.90[a]	26.10[b]	0.74	0.00
Weight gain. g	257.50[a]	217.50[b]	6.18	0.00
Initial *Eimeria sp* (opg)	12.61	10.48	1.18	0.21
Initial *Haemonchus sp* (hpg)	2.93	3.62	0.76	0.53
Initial *Cryptosporidium sp* (opg)	11.75	10.95	1.03	0.59
Final *Eimeria sp* (opg)	8.32	8.42	0.96	0.94
Final *Haemonchus sp* (hpg)	0.00	0.00	0.00	0.32
Final *Cryptosporidium sp* (opg)	3.29	2.79	0.00	0.62
Order *Strongylidea* (hpg)	0.00	0.00	0.00	1.00

[a-b] Means with the same letters in the same row do not differ statistically according to the Tukey test.

After 120 days of research, coproparasitic analyses reported a decrease in the parasitic load of *Eimeria* spp, without reporting significant statistical differences ($P > 0.05$). Due to the effect of sex when applying diatomaceous earth, final OPG (oocysts per gram of feces) counts were obtained in males of 69.22 and in females of 70.89. Numerical differences were obtained in which the treatments registered a greater efficiency in males with 58.47% vs. 35.46% of females. This phenomenon can be attributed to what Bouissou et al. (2001) and Jurkovich et al. (2024) mention; that the social behavior of cattle is very influential in the well-being of the herd, since at feeding time the males displace the females, causing stress and submission. These are the reasons for a depression in the immune system of females, decreasing their response capacity to diseases.

Whereas that for *Cryptosporidium sp*, after 120 days of research, using the four treatments Control, T1, T2, and T3 (150, 175, and 200 g diatom/day), the parasitic load in males was reduced from 138.06 OPG to 10.82 OPG and in females from 119.90 OPG to 7.78 OPG. These results do not report significant statistical differences ($P > 0.05$). According to the sex of the animals, the percentage of effectiveness of the treatments in both females and males is similar, having 92.17% in males and 93.52% in females. This slight "supremacy" of females may be due to what Borchert and Zellmer-Bruhn (2010) explain: males at the beginning of their puberty tend to produce and elevate their sexual hormones. These suppress the humoral and cellular response and therefore can become susceptible to coccidiosis attacks.

Finally, when using diatomaceous earth as an antiparasitic and cattle-fattening agent, the economic responses, assuming that the animals are sold at live weight, showed a balanced profitability between the control treatment Control, 1% ivermectin, and T2 (175 g/diatom), with a cost benefit of 1.22 for T1 and 1.20 for T3. Higher values compared to treatments Control, which reported cost benefits of 1.18 and 1.16, respectively. It should be noted that diatomaceous earth was administered daily, compared to ivermectin, which was administered as a single application at the beginning of the experimental work.

***Conclusion*:** Diatomaceous earth proved to be an effective antiparasitic alternative in fattening cattle, especially at doses of 175 g/day and 200 g/day, which resulted in final weights of 187.5 kg and 182.6 kg, respectively. Weight gains reached up to 34.6 kg over 120 days, with daily gains of 288.33 g in the highest dose group. The treatment significantly reduced Eimeria sp. oocysts, achieving up to 57.76% effectiveness, while ivermectin showed a negative effect. Although no statistical differences were found for *Cryptosporidium* spp., numerical reductions were observed. These findings highlight the potential of diatomaceous earth as a natural, sustainable strategy for improving cattle health and productivity.

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Oñate Mancero, E. Oleas Carrillo completed the experiments; S.A. Guamán-Rivera, G.C. Herrera- Morales, M. Fiallos, J,C. Benavides Lara, F.P. Erazo Rodriguez, F.J. Oñate Mancero, E. Oleas Carrillo prepared the draft; S.A. Guamán-Rivera reviewed and finalized the draft.

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***Consent to participate*:** All participants consented for this research study.

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***Policy referred*:** Sustainable Animal Health Management; Food Safety and Public Health; Climate-Adapted Livestock Management.

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